Ozone Geospatial Distribution in Great Smoky Mountains National Park

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Study Design and Objectives

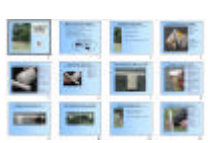
A detailed spatial characterization of Great Smoky Mountains National Park ozone concentrations was needed to better understand the representativeness of the existing fixed-location stations. Weekly sampling with passive ozone samplers is an inexpensive and reliable method to get ozone concentrations. However, walking into to a large number of sites was beyond the staff time available. Volunteers were obtained from local organizations interested in the park. Over 300 people volunteered to join the project; 50 were chosen based on availability and access to the trails.

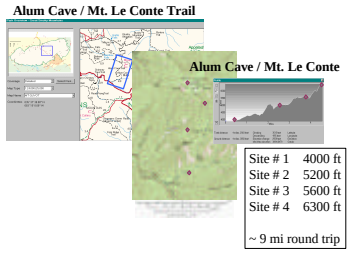
Over 50 sites were selected, mostly along drainage transects, to cover a significant portion of the park. The locations and data were entered into a Geographic Information System (GIS) so that interpolated data maps could be obtained for the seasonal spatial distribution of ozone. Data from other monitoring stations surrounding the park were obtained for AIRS to supplement the in-park data.

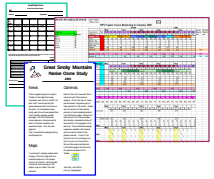
The key product from the project was to be the ozone distribution maps that could be used with overlays of other ecosystem factors such as vegetation, sensitive species, elevation, etc. These maps were produced by first creating an ozone estimate by elevation. The difference between the elevation-estimated ozone and the observed ozone at the monitoring sites was calculated and an interpolation produced. This interpolation of the error was then subtracted from the elevation estimated ozone to produce a map of the elevation corrected ozone estimate.

Picture Overview

Preparation and Training

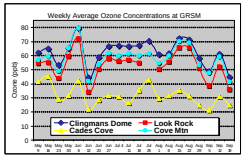






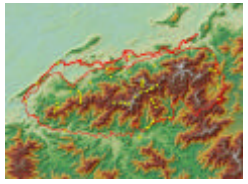
A detailed schedule for sample shipments and field deployment of samplers was prepared for the lab contractor and volunteers. A training slide-show, logsheets, and detailed maps guided the volunteers. Hands-on training and team assignments was done before the start of the program. During the field program a newsletter and web site kept everybody informed.

Field Observations



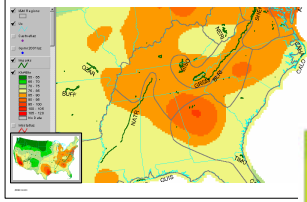
Weekly ozone concentrations were tracked from the continuous ozone analyzers in the park at 4 locations. Data was posted up to the web site weekly.

The map of the park below shows the location of the monitoring stations used to produce the ozone interpolations. Using these stations ozone interpolation maps are able to capture the changing values in the mountain areas indicated below.



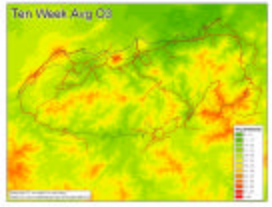
Analysis and Spatial Mapping

Interpolation Estimates of Average Annual 4th Highest Daily 8-hr Max. Ozone



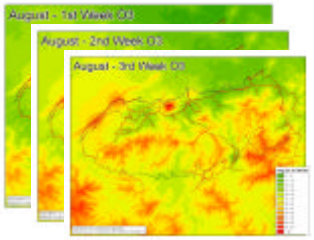
The ozone map to the left is an example of the general concentrations that can be obtained with the existing network of monitoring stations. All of Great Smoky Mountains NP falls into the same broad ozone area in orange.

The ozone map to the right demonstrates the more detailed map produced using the additional monitors installed for this study. This map shows the elevation-corrected ozone estimate for the 10-week intensive period of the study (3rd week June to end of August).



Results

The three maps here show the detail possible for modeling weekly ozone distribution. A regional model with only continuous monitoring stations (such as in the frame to the left) may be useful for discerning general trends, however, using the additional passive sampler monitor data along with elevation data allowed for a model that improved spatial detail down to 30m resolution. For example, the ridge on the west side where Look Rock station is located has ozone detail for the entire ridge. Future studies utilizing other co-factors such as slope, aspect, temperature, vegetation cover and land use are already underway and should aid in further refining ozone estimates.



Ozone concentrations go from low (green) through yellow to high (red) in these maps. An ozone gradient of increasing concentrations with elevation was seen throughout the park. The regional background field for ozone was quite different on the north and south sides of the park.

With a denser network of monitoring stations, the spatial distribution of ozone can be determined even in mountainous areas. Deployment of large networks of monitors can be done successfully using volunteer help.